STATE OF ILLINOIS
HENRY HORNER, *Governor*
DEPARTMENT OF REGISTRATION AND EDUCATION
JOHN J. HALLIHAN, *Director*

DIVISION OF THE
STATE GEOLOGICAL SURVEY
M. M. LEIGHTON, *Chief*
URBANA

REPORT OF INVESTIGATIONS—NO. 60

PRELIMINARY GEOLOGIC MAP OF THE MISSISSIPPIAN FORMATIONS IN THE DONGOLA, VIENNA, AND BROWNFIELD QUADRANGLES

BY

STUART WELLER AND FRANK F. KREY

EXPLANATION AND STRATIGRAPHIC SUMMARY

BY

J. MARVIN WELLER

PRINTED BY AUTHORITY OF THE STATE OF ILLINOIS

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This Report is a Contribution of the Section of Geological Resources, Division of Stratigraphy and Paleontology.

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INTRODUCTION

THE MISSISSIPPIAN rocks of Illinois crop out in three distinct areas along the western and southern borders of the State. The northernmost of these is the largest and extends along Mississippi River from Mercer County on the north to Madison County on the south and also includes the outcrops along Illinois and Spoon rivers as far north as Fulton County. The second area occupies portions of St. Clair, Monroe, Randolph, and northwestern Jackson counties, extends for about 90 miles along the bluffs of Mississippi River from a short distance below East St. Louis to about 20 miles below Chester, and includes an area extending eastward from the bluffs to a maximum width of about 15 miles. The third area is in the extreme southern portion of the State, and extends as a belt ranging from 6 to 20 miles in width from Union County on the west to Hardin County on the east.

This report is concerned with the central part of the third of these areas and describes the geology of those portions of Union, Johnson, Pope, Alexander, Pulaski, and Massac counties included within the Dongola, Vienna, and Brownfield quadrangles (fig. 1). The eastern part of this southern area of Mississippian outcrops, including Hardin and the adjoining portion of Pope County, has been described in Bulletin 41 of the Illinois State Geological Survey.[1] The geology of the Carbondale quadrangle, which lies north of the Dongola quadrangle and includes parts of Jackson, Williamson, Union, and Johnson counties has likewise been described.[2] The western part of this third area of Mississippian outcrops will be described in a future Report of Investigations devoted to the pre-Pennsylvanian geology of the Alto Pass, Jonesboro, and Thebes quadrangles.

FIELD WORK

The Brownfield quadrangle was mapped by Stuart Weller in 1916-18 and the Vienna quadrangle in 1918-19. In 1925 the mapping of the Brownfield quadrangle was revised. Frank F. Krey mapped the Dongola quadrangle in 1921.

The following descriptions of formations are based largely on manuscript reports on "The Geology of parts of Johnson and Pope counties," by Stuart Weller, and "Geology of the Dongola quadrangle," by Frank F. Krey.

STATUS OF MAPS

The separate quadrangle maps were never completed for publication. Because of the present need for the geologic information

[1] Weller, Stuart, and others, The geology of Hardin County and the adjoining part of Pope County: Illinois State Geol. Survey Bull. 41, 1920.

[2] Lamar, J. E., Geology and mineral resources of the Carbondale quadrangle: Illinois State Geol. Survey Bull. 48, 1925.

they are issued at this time in preliminary outline form on a sectionized base and show the areal distribution of the various formations on a scale similar to that of the standard fifteen minute topographic quadrangles of the U. S. Geological Survey. They have been traced directly from the original manuscript geologic maps without alteration or addition and are intended to be used in conjunction with the engraved quadrangle topographic maps. They are preliminary and subject to correction.

The geologic mapping is incomplete in certain critical areas where additional field studies are necessary, and the strata exposed in some small fault blocks have not been identified. Particular attention is directed to the following areas:

1) Dongola quadrangle. Because it is thin and rarely well exposed the Bethel sandstone is not shown separating the Renault and Paint Creek formations. It is, however, probably present at most places.

2) Central part of Brownfield quadrangle. Sandstone occupying one or more small fault blocks has been doubtfully identified. The Chester sandstones are so similar that they cannot be certainly identified except where their relations to the associated limestone-shale formation can be observed.

3) Southwest corner of Brownfield quadrangle. Sandstones exposed in some of the fault blocks have not been identified.

4) Fault block southwest of Reevesville. Sandstone included in this fault block was identified as Hardinsburg in the Brownfield quadrangle and Tar Springs in the Vienna quadrangle. The latter is probably correct.

IOWA SERIES

The Kinderhook group is represented in the Dongola quadrangle by the greenish Springville shale and possibly also by the underlying black Mountain Glen shale. The Osage and Meramec groups consist of a thick conformable sequence of limestone which undoubtedly includes strata equivalent to the various formations of the standard Mississippian section, but the formation boundaries are indistinct and it is not possible to separate definitely all of the formations that are recognized elsewhere.

FIG. 1.—Index map of southern Illinois showing the location of A, Dongola; B, Vienna; and C, Brownfield quadrangles.

Mountain Glen shale.—This formation of Upper Devonian or Lower Mississippian age consists of hard black shale about 50 feet thick. It crops out only in the southwest part of the Dongola quadrangle, where it occurs at the foot of the bluffs in secs. 17, 20, and 21, T. 14 S, R. 1 W. It is well exposed on the south slope of the isolated hill near the center of sec. 20, but easily accessible and better outcrops are present in the Jonesboro quadrangle south of the road near the west line of sec. 11 and below the spillway of the dam at the State Pond near the middle of the S. ½ sec. 14, T. 12 S., R. 2 W. It overlies the Alto formation (Devonian) unconformably and is likewise succeeded unconformably by the Springville shale. It is locally absent in the Jonesboro quadrangle.

Springville shale.—This formation overlies the Mountain Glen shale north of Mill Creek in the southwestern corner of the Dongola quadrangle. In this area it is 25 to 30 feet thick and consists of greenish shale. The lower 8 to 10 feet is soft but higher beds become increasingly siliceous and the upper portion strongly resembles chert. The harder portion of the formation weathers to iron-stained chips whose surfaces are commonly mottled red, blue, and brown. It may be seen north of the road near the center of sec. 21, T. 14 S., R. 1 W., and an excellent exposure occurs in the Jonesboro quadrangle beside State Highway No. 146 in the NE. ¼ sec. 23, T. 12 S., R. 2 W.

Burlington-Keokuk formation. — Strata of Burlington-Keokuk age are mainly confined to the hills west of Mill Creek in the

southwest part of the Dongola quadrangle. They consist of about 300 feet of fine-grained dark bluish-gray limestone, which may be more or less siliceous, and banded chert. At some places parts of the formation consist entirely of chert but elsewhere chert may constitute no more than ten per cent of the rock. Both limestone and chert rarely occur in beds more than one foot thick. Good exposures are present at the bridge over Mill Creek in the NW. ¼ sec. 22 and in the hillside north of the road in the NW. ¼ sec. 21, T. 14 S., R. 1 W.

Warsaw-Salem limestone. — This limestone crops out northeast of Mill Creek, from the western boundary of the Dongola quadrangle to Wetang, and is about 200 to 250 feet thick. It appears to be conformable with both underlying and overlying beds. Although strata equivalent in age to both the Warsaw and Salem formations as recognized farther north in the Mississippi Valley are undoubtedly present, they cannot be distinguished in southern Illinois, where they consist mainly of light gray coarsely granular crinoidal limestone in massive beds that commonly spall off in plates parallel to the exposed surface. The lower portion includes beds that are finely granular and bluish-gray, and some chert is present in this and the uppermost part of the formation. The best exposure of the lower part of the formation is in the old quarry in a bluff about 1½ miles north of Ullin. Higher beds are well shown in the W. ½ sec. 28, T. 13 S., R. 1 W.

St. Louis limestone.—The St. Louis limestone is about 350 feet thick in the Dongola quadrangle and crops out in a zone three to four miles wide extending southeast from south of Anna to the Cache River bottoms near Perks. It consists mainly of medium-grained dark gray strata with more or less interbedded granular limestone resembling the underlying Warsaw-Salem, though darker colored. The lowest 25 to 30 feet of the formation is dark gray fine-textured siliceous limestone, and the upper part is composed of dark bluish-gray beds that are fine-grained to sublithographic in texture. Chert is present throughout the entire formation but is most abundant in the finer grained portions. Some oolitic beds occur but the oolites are generally smaller and darker colored than in the Ste. Genevieve. The lower strata are well exposed along the road near the center of sec. 17, T. 13 S., R. 1 W. Oolite may be seen along the road west of Dongola in the NW. ¼ sec. 25, T. 13 S., R. 1 W. Upper St. Louis beds occur in the southwest bank and bed of a creek in the NW. ¼ sec. 23, T. 13 S., R. 1 W.

Ste. Genevieve limestone.—The outcrop of this formation extends southeast from Anna to White Hill and Belknap. It overlies the St. Louis limestone conformably and attains a thickness of about 300 feet. In Hardin County, Illinois, and in western Kentucky the Ste. Genevieve is subdivided into three members, the Fredonia limestone at the bottom, the Rosiclare sandstone in the middle and the Levias limestone at the top. These members are recognized in the Dongola quadrangle but because of inadequate outcrops they cannot be separately mapped. In addition to these a variable succession of clastic beds including some limestone overlies the Levias limestone in Union County and for these the name Hoffner member is proposed.

The Fredonia member consists of massive limestone in beds generally three to four feet thick which vary considerably in lithology. Some of them are similar to the underlying St. Louis formation but commonly they are somewhat lighter colored and coarser textured. Beds of white more or less cross-bedded oolite are present at several horizons, and many of the other layers contain scattered oolites. Some chert is present, particularly in the lower part and in the darker-colored and finer textured layers, and a few more or less sandy beds occur in the upper part. This member is 175 to 200 feet thick and is very well exposed in the quarries of the Anna Quarry Company east of Anna and the Charles Stone Company at White Hill.

The Rosiclare member is a fine-grained more or less calcareous sandstone whose thinner layers are commonly separated by greenish shaly partings. It is 10 to 12 feet thick and is rarely well exposed. This member may be best seen at the top of the face of the Charles Stone Company's quarry at White Hill.

The Levias member is similar to the Fredonia except that it is commonly less cherty and can be identified only where the Rosiclare sandstone is exposed beneath it.

The Levias member probably attains a thickness of about 40 feet.

The Hoffner member lithologically resembles strata of the Chester series but its fossils include characteristic Ste. Genevieve rather than Chester species. It appears to have a thickness of between 50 and 80 feet and consists mainly of sandy shale and fine-grained standstone that is locally rather massive. With these strata are associated red shales at several horizons and in the middle part of the member are one or more limestones. The most characteristic type of limestone occurs in thin lenticular sandy and somewhat oolitic beds that are mottled red and green. Other limestones closely resembling those of the Fredonia and Levias members attain a thickness of 10 feet or more and are locally massive and richly oolitic. This member is well exposed along Swan Creek northeast of Anna in the E. ½ sec. 17, T. 12 S., R. 1 W. and east of Hoffner school in the W. ½ sec. 8, T. 13 S., R. 1 E.

CHESTER SERIES

All of the formations of the standard Chester section except the Aux Vases sandstone are present in this area. The Bethel sandstone is thin and possibly discontinuous except near Ohio River but the Waltersburg sandstone achieves its best development in this region. On the whole, the Vienna quadrangle is a favorable area in which to observe the succession of the Chester formations. They are little disturbed by faulting and as there is no glacial drift most of the gently dipping sandstones form more or less continuous ridges that sharply separate the various limestone-shale formations with which they alternate.

Renault limestone.—This formation crops out along a narrow zone extending from the northwest corner of the Dongola quadrangle southeast to a point five or six miles beyond U. S. Highway 45 and also in the bluffs on both sides of Bay Creek adjacent to Ohio River. It is well exposed in a quarry near Belknap in the NE. ¼ sec. 1, T. 14 S., R. 2 E.

The Renault overlies the Ste. Genevieve limestone unconformably and attains a thickness of 60 or more feet. It consists mainly of hard gray limestone that is more or less crystalline and locally oolitic. Individual ledges separated by variable amounts of shale are somewhat massive and in part notably cross-bedded. A little chert is present in the upper part. Shale is rarely exposed and is mainly gray or greenish but red beds are present in Union County.

Bethel sandstone.—The Bethel sandstone attains its greatest thickness of about 130 feet between Cave and Barren creeks in the southeast corner of the Brownfield quadrangle and is about 80 feet thick in the bluffs north of Bay Creek. West of Pope County, however, it is a thin and generally inconspicuous formation and unlike other Chester sandstones has little effect upon topography. Near Belknap it is about 30 feet thick but elsewhere rarely exceeds 15 feet and appears to be entirely absent locally. It is believed to overly the Renault limestone unconformably and is well exposed above that formation in the railroad cut at Indian Point in the SW. ¼ sec. 32, T. 13 S., R. 3 E.

The Bethel is a fine-grained yellowish-brown cross-bedded sandstone that is generally very massive and cliff-forming where it is thick, but it is thin-bedded, shaly, and rarely well exposed where it is thin.

Paint Creek formation.—The Paint Creek formation consists principally of shale and attains a thickness of 40 to 60 feet, being thickest to the east. The shale is commonly grayish or greenish and where fresh may be nearly black. Locally it weathers to a conspicuous red color that is characteristic of this formation. Limestone is generally present, in thin layers, but may be entirely lacking. It is light colored, more or less crystalline, but commonly impure, and locally appears to grade into calcareous sandstone or become conglomeratic. Because of its shaly nature this formation is rarely well exposed. A good outcrop may be seen along the secondary road in the SW. ¼ sec. 34, T. 13 S., R. 3 E.

Cypress sandstone.—This formation is the most persistently thick and massive sandstone in the Chester series. It forms an escarpment that extends from the northwest corner of the Dongola quadrangle southeast to the bottomlands that connect the valleys of Cache River and Bay Creek. Other bluffs produced by this formation are present both north and south of Bay

Creek farther to the east. The thickness of the Cypress sandstone is difficult to estimate but it probably exceeds 100 feet nearly everywhere. It consists of gray to yellowish medium-grained sand that weathers brown. The main central part of the formation is very massive, but thin-bedded strata are present in both the lower and upper parts. Cross-bedding is common. The formation is well exposed near the village of Cypress but was named for Cypress Creek many years before that town was established. The contact of the formation with the underlying Paint Creek is well exposed in the Ohio River bluffs just below Golconda along the road leading to Dam No. 51.

Golconda formation.—The Golconda formation consists of interbedded limestones and shales. At most places limestone appears to dominate the upper part and also to be relatively abundant in the lower part, but the middle part consists almost exclusively of shale. The limestones are generally more or less crystalline and vary from light gray to bluish-gray in color. Some oolite is locally present. The shales vary from nearly black to light gray or greenish and some are very calcareous. A little reddish shale is locally present. The Golconda formation is generally more than 100 feet thick and attains its greatest thickness of about 150 feet south of Vienna, but in southeastern Johnson County south and west of Ganntown it seems to be no more than 40 feet thick. The formation is well exposed by the roadside in the SW. ¼ sec. 2, T. 13 S., R. 1 E.

Hardinsburg sandstone.—The Hardinsburg sandstone is similar to the Cypress in general character and forms a well-marked escarpment north of and parallel to the series of ridges capped by the Cypress formation. It is most massive in its lower part and is probably separated from the Golconda formation by an erosional unconformity that accounts for the variable thickness of the underlying formation. The Hardinsburg sandstone is thickest to the east and thins to the west. It is 100 feet thick where it is well exposed in the Ohio River bluffs above Golconda, just east of the Brownfield quadrangle. This thickness continues into Johnson County, where the formation thins irregularly and locally is apparently no more than 30 feet thick, and in Union County it is probably nowhere more than 50 feet thick. As it thins westward the Hardinsburg sandstone becomes somewhat more thin-bedded and shaly and locally includes dark shale. It is excellently exposed at the top of the bluff southeast of Brownfield.

Glen Dean formation.—The interbedded limestones and shales of the Glen Dean formation are similar to those of the Golconda and can be distinguished with certainty only by fossils. In general, limestones are abundant in the upper part and shales in the lower, although this situation may be reversed. A little chert is locally present and some oolite occurs near the top of the formation in the Dongola quadrangle. The thickness of the formation is generally about 60 to 80 feet but locally east of Vienna the upper beds appear to be absent and the Glen Dean is represented by about 40 feet of shale. The formation is well exposed by the roadside in the north-central part of sec. 35, T. 12 S., R. 1 E.

Tar Springs sandstone.—The Tar Springs is a fine-grained cross-bedded sandstone similar to the Hardinsburg and Cypress sandstones and forms a third scarp north of and parallel to the others. Like the Hardinsburg it is variable in lithology, massive in some areas and thin-bedded or even shaly in others. In general the more massive beds occur in the upper and lower parts of the formation separated by shaly strata that include a coaly horizon in Johnson and Pope counties. The coaly horizon is exposed by the roadside in the NW. ¼ SE. ¼ sec. 6, T. 13 S., R. 3 E. The Tar Springs sandstone is thickest to the east where in eastern Pope County it attains a maximum of 100 to 150 feet. It is probably nowhere more than 100 feet and it appears to average 60 to 80 feet thick in Johnson and Union counties but locally, northwest of Grantsburg, it is little more than 40 feet thick. Its contact with shale of the underlying Glen Dean formation may be seen along Highway 146 three miles east of Vienna.

Vienna limestone.—This formation consists principally of dense bluish-gray chert-bearing limestone with some dark shale, particularly in the upper part of the formation, but locally the shale exceeds the limestone. The limestone is very siliceous and

commonly weathers to porous more or less ocherous residuum. This residuum and the dark chert are characteristic of the formation. This formation ranges in thickness from a maximum of 60 to 70 feet in the east to 30 or 40 feet in the west. The best exposure is along the cut of Illinois Central Railroad in sec. 12, T. 13 S., R. 4 E. where a thin coal is present at the base of the limestone. At the north end of the cut part of the limestone is completely weathered to the characteristic cherty residuum.

Waltersburg sandstone.—The Waltersburg is an important sandstone only in the Brownfield quadrangle and the eastern part of the Vienna quadrangle. Its maximum thickness of 60 to 70 feet is attained along Bay Creek northwest of Grantsburg, but it is well developed as far east as Waltersburg, in which areas it is very massive, produces scarps, and stands in vertical cliffs closely resembling the Cypress sandstone. To the east and west it thins rapidly, becomes shaly, and probably nowhere exceeds 30 or 40 feet in thickness. In its thinner development the Waltersburg includes thin layers of very fine-grained tough sandstone which characteristically break into blocks two to four inches wide and thick and a foot or more long.

Menard limestone.—The Menard limestone is one of the most uniform formations of the Chester series. In southern Illinois it is generally about 100 feet thick but may thin slightly from east to west. The limestone is mostly fine-grained and bluish-gray and weathers with smooth surfaces, although lighter colored more crystalline layers are not uncommon. Individual strata are generally a foot or less thick with uneven surfaces and are separated by partings or layers of shale. Chert is more common than in any of the lower Chester limestones except the Vienna. Considerable shale is present, particularly in the middle and lower parts. This formation is best exposed in the cut at the south portal of the Illinois Central Railroad tunnel in sec. 1, T. 13 S., R. 4 E., and the limestone may be seen also along Highway 37 half a mile north of West Vienna.

Palestine sandstone. —This formation is generally thin-bedded or even shaly and does not produce a conspicuous scarp like several of the other Chester sandstones. Its most massive and thickest development occurs east of Bay Creek in the vicinity of Flatwoods, where it is about 80 feet thick. Both to the east and west it thins to 40 or 60 feet. Massive beds may be present locally in the upper part. This sandstone may be seen overlying the Menard formation in the cut at the north portal of the Illinois Central Railroad tunnel in sec. 36, T. 12 S., R. 4 E.

Clore formation.—This formation consists mainly of shale, although several feet of limestone in thin beds separated by shale is commonly present in the upper part, and thin lenticular limestones and calcareous nodules occur elsewhere. The limestones are generally fine-grained and dark bluish-gray. The shales are mostly dark gray to greenish and more or less calcareous. The Clore formation attains a thickness of 30 to 40 feet at most places but locally may be no more than 20 feet thick. It is best exposed in a railroad cut in the SW. ¼ SW. ¼ sec. 23, T. 12 S., R. 2 E., about half way between West Vienna and Buncombe.

Degonia sandstone.—The Degonia is one of the thicker and more massive of the Chester sandstones and locally resembles the Cypress sandstone and the lower massive sandstones of the Pennsylvanian system. It is about 100 feet thick in the Vienna quadrangle and locally produces a well-marked scarp, but its effect on the topography elsewhere is masked by the more prominent scarp of the Pennsylvanian sandstone. Eastward, in the Brownfield quadrangle, the formation becomes somewhat thinner and less massive. The lower beds of the Degonia are commonly thin-bedded and somewhat shaly, and the massive strata in the upper part are generally separated by thinner layers. Some of its massive beds are well exposed near Glendale in the Brownfield quadrangle, and it may be seen overlying the Clore formation in a road cut in the NE. ¼ SE.¼ sec. 19, T. 12 S., R. 4 E.

Kinkaid limestone.—This formation closely resembles the Menard in lithology and bedding. Chert, however, is much more abundant and marks the weathered outcrop of the Kinkaid at most places. Light-colored granular limestone is likewise somewhat more abundant than in the Menard, and red beds are present at many places

in the shaly lower portion of the Kinkaid. The formation may attain a maximum thickness of about 140 feet, but it was subject to considerable pre-Pennsylvanian erosion and is generally less than 100 feet thick and locally has been reduced to 60 or 70 feet. It is best exposed in the Illinois Central Railroad cut at Robbs in the Brownfield quadrangle and here its gradation into the underlying Degonia sandstone may be observed. Reddish Kinkaid shale is exposed just south of the road in the NE. ¼ NE. ¼ sec. 20, T. 12 S., R. 4 E.

Pre-Pennsylvanian Unconformity

The Mississippian and Pennsylvanian systems are separated by an important erosional unconformity. Erosion in this part of southern Illinois, however, was not severe and nowhere was the Kinkaid limestone at the top of the Chester series completely removed before the first Pennsylvanian sediments were laid down. Erosion at this systemic contact is, however, reflected by the variable thickness of the Kinkaid which ranges from less than 70 to 140 feet or more.

Pennsylvanian System

Pennsylvanian beds overly the Mississippian in the northern parts of the Vienna and Brownfield quadrangles and extend southwestward in the Dixon Springs graben nearly to Bay Creek. The most prominent member of the basal Pennsylvanian Caseyville formation is the Lick Creek sandstone. This is a thick massive ridge- and cliff-forming sandstone similar to the better developed sandstones of the Chester series but distinguished from them by the common but more or less local occurrence of rounded quartz pebbles. Below the Lick Creek sandstone at most places is the basal Wayside member of the Caseyville formation, consisting mainly of more or less sandy shale and thin-bedded sandstone.

Cretaceous and Tertiary Deposits

Unconsolidated Cretaceous and Tertiary sediments are extensively distributed south of Cache River and Bay Creek and are much more locally present in the area to the north. They consist of various types of clays, sands, and gravels, some of which are partly cemented with limonite.

Structure

The area covered by this report lies at the southern tip of the Illinois basin into which all of the formations dip. The strike of the strata across the Dongola quadrangle is nearly northwest-southeast. Dips to the northeast range in general from 1 to 2 degrees, the older strata dipping a little more steeply than the younger ones. In the Vienna quadrangle the strike becomes more nearly east-west and dips of the strata become generally more gentle.

There are several faults, mostly trending northwest-southeast or northeast-southwest, in the area but displacements are small and exceed 100 feet at only a few places. Extending northeast-southwest across the Brownfield quadrangle is the Dixon Springs graben, one of the most prominent structural features of southern Illinois. This graben occurs in the midst of a complex series of northeast-trending faults which parallel the main mineralized veins of the fluorspar district farther east in Hardin County, Illinois, and Crittenden County, Kentucky. The graben is not a simple one because it is bounded by fault zones rather than single faults and is itself faulted. The combined displacements of the faults that bound it amount to nearly 1000 feet at some places. In it Pennsylvanian beds extend southwest nearly to Bay Creek.

No reversals of dip are known except in a few of the smaller fault blocks and no anticlinal structures have been discovered in this part of southern Illinois.

The structure of the Paleozoic rocks south of Cache River and Bay Creek is uncertain because they are covered by Cretaceous and Tertiary deposits, and outcrops of the indurated rocks are few. So far as known, however, the strata dip gently to the northeast and north and are broken by faults similar to those observed farther to the north.

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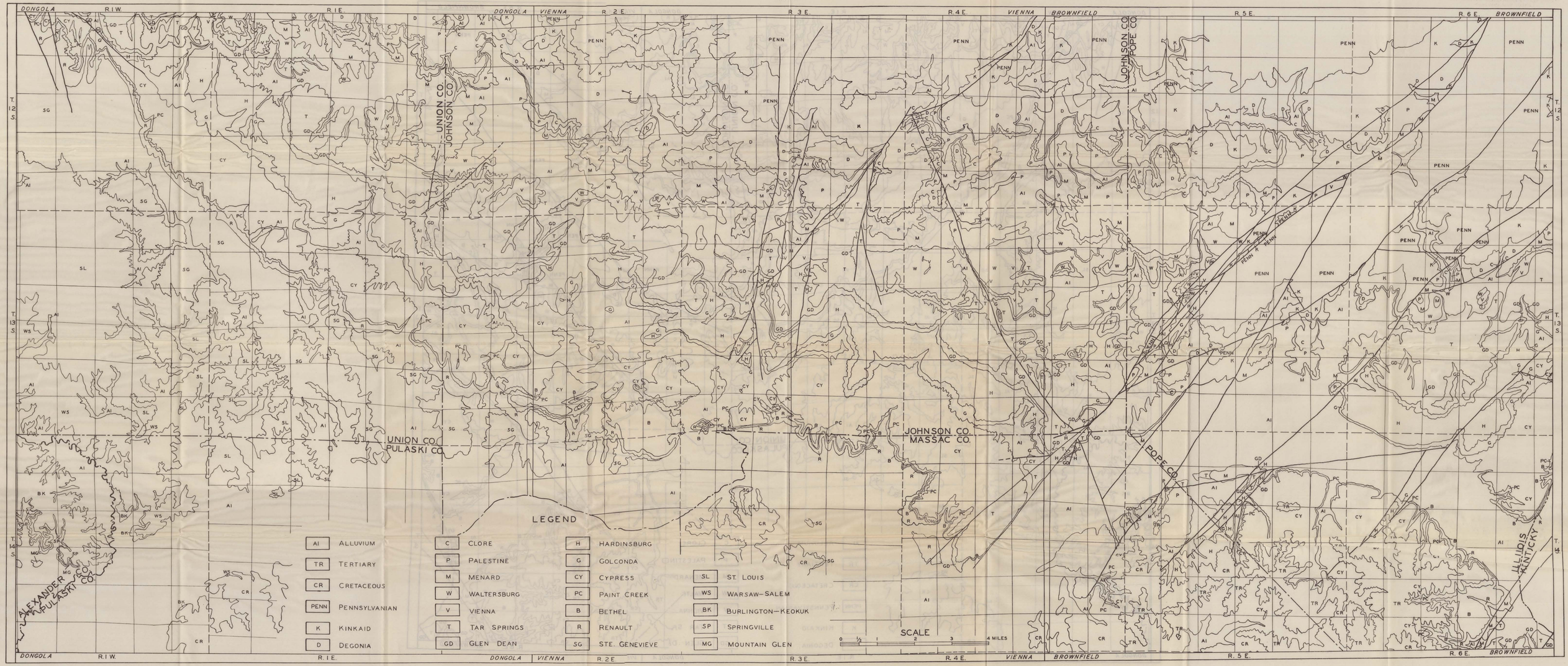
REPORT OF INVESTIGATIONS NO. 60, PLATE I



PRELIMINARY GEOLOGIC MAP
SUBJECT TO REVISION

DONGOLA QUADRANGLE — VIENNA AND BROWNFIELD QUADRANGLES

BY FRANK KREY (1921) BY STUART WELLER (1916-1919)